Lawrence Livermore National Laboratory

# Structured/Unstructured Hybrid Mesh Hydrodynamics and Heat Conduction Studies

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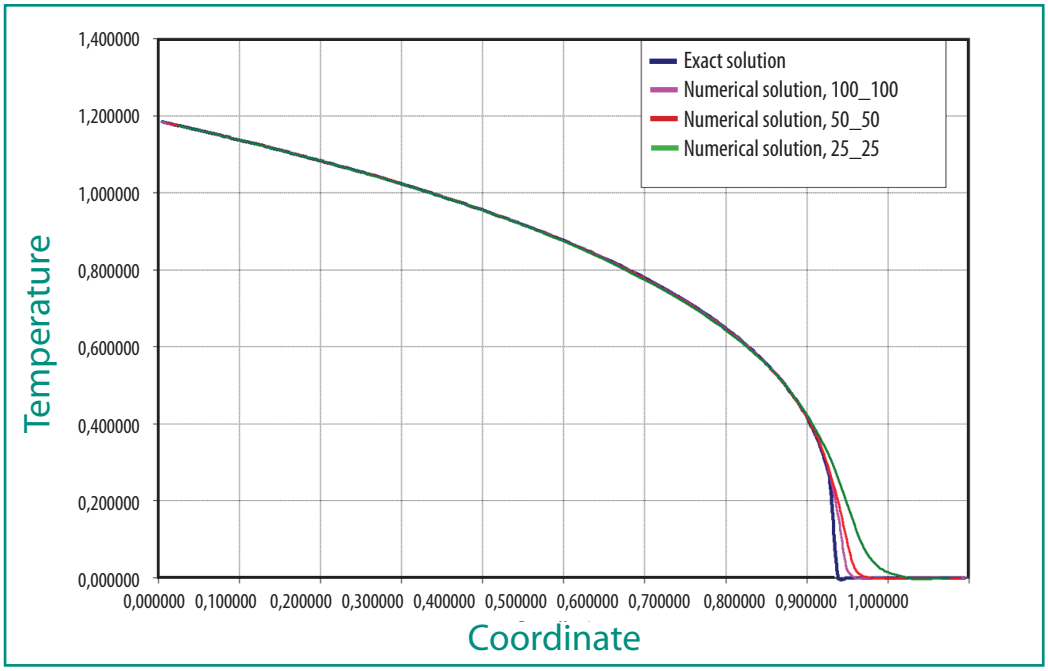
## Project Description

The objective of this research is to develop and implement a methodology for two-dimensional hydrodynamics and heat conduction that allows the combined use of structured and unstructured meshes in the same simulation. The flexibility allowed by such "hybrid" meshes will expand the number of problem types that can be efficiently meshed and simulated. The algorithm is implemented in a benchmark code using analytical forms for all physical data such as the equation of state, heat conduction coefficients, etc. This project developed a serial version of the code, and a subsequent project develops a parallel version of the code.

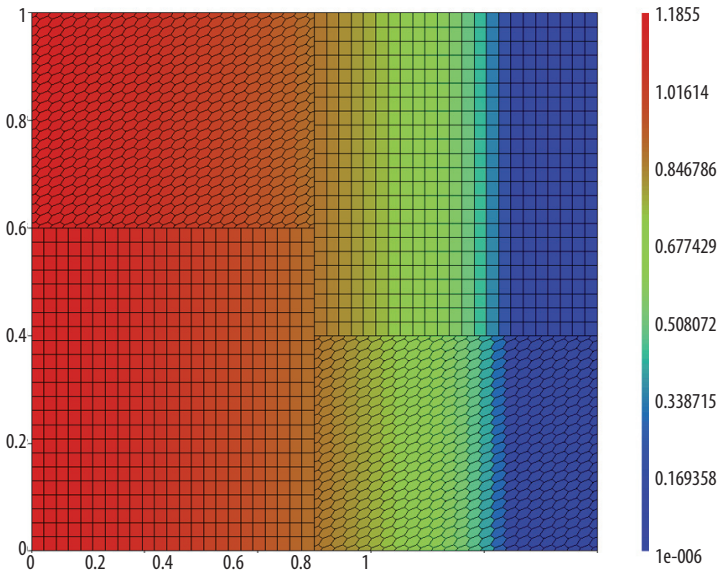
Finite-difference equations were derived on combined grids using implicit difference schemes. A technique for transferring energy flow at the interface between grids was developed, together with a technique for the derivation of a simultaneous linear equation system and a solver for the single linear equation system. Algorithms were developed and implemented for the numerical solution of the equations using combined grids. The project also involved integrated debugging of the programs and test computations to verify the numerical implementation of the algorithms.




Temperatures for the exact and numerical solutions on grid 8.

## Technical Purpose and Benefits

The accurate simulation of hydrodynamic and heat conducting flows requires significant computational resources. While a variety of adaptive mesh technologies exist, each has important drawbacks and inefficiencies. This project developed an adaptive hybrid mesh technology allowing the numerical solutions in different regions of a complex flow to be obtained using the most appropriate and computationally efficient mesh. In particular, a problem can be simulated using an unstructured grid in regions with complex boundaries and a structured grid in less geometrically complex regions.




Temperatures for the numerical solutions on grid 8.

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